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FOOD SUPPLIES IN A JAPANESE INTERNMENT CAMP

The surrender of Hongkong on December 25, 1941 foreshadowed new experiences in the art of eating for the American, British, and Dutch civilians interned there. Until that date, the British government had established food kitchens which fed over 100,000 Chinese daily, and had maintained supply depots where non-Chinese residents obtained rations of meat, bread, beans, rice, and powdered milk. Upon the fall of the city, the supplies in most depots were quickly exhausted.

On January 4, 1942, citizens of countries with which Japan was at war were instructed to report for internment, bringing such clothes, bedding, and food for two days as each could carry. Those living on the mainland went to the Kowloon Hotel, those on the island to fourth and fifth class hotels, the Japanese army having settled in the better ones. After two difficult days, notices were issued that the Army would supply a "basic" ration of rice, sugar, flour, salt, and peanut oil and a secondary ration of meat and vegetables. The internees were to advance funds for the secondary ration, although all payment checks were later returned and settlement postponed indefinitely.

During this temporary stay, there were occasional complaints of "tainted" meat and general agreement as to the poor quality of the diet, but this period was only a bad taste of the conditions to come. On January 17 the Japanese army moved the internees to Stanley, about 6 miles from the city. The Americans and Dutch were housed in the quarters of the British wardens of the Hongkong prison, and in the school buildings, dormitories, and staff residences of St. Stephen's college, a missionary boarding school for Chinese boys. At one time there were 316 Americans, 2470 British, and 70 Dutch nationals interned at Stanley.

A scale of rations was announced on January 21 which aroused considerable complaint; after investigation and change of administration, somewhat better rations were issued after March 25. Representatives of the Japanese army issued the foodstuffs but took no responsibility for the provision of kitchens or for the cooking or serving of the food, resulting in considerable improvisation in cooking and eating utensils. The rations, weighed and signed for, were issued each day. Entire lack of refrigeration, especially during the warmer weather, accounted for many a meatless day, although meat or fish proved spoiled upon issue was often replaced by canned meat products, if available. Two meals a day were served to the adults, three to the children. The latter received, in addition to other food, evaporated or fresh milk. Infants were given an imperial pint of fresh milk daily. Sacrifice on the part of the adults maintained the children in surprisingly good health. Food was generally prepared in the form of rice and meat stews, and although the quality of the rice was very poor, it did at least provide some humor in discussions of the size and distribution of larvae and weevils encountered.

Americans preparing for repatriation on June 29 were forbidden to retain any handwritten or typewritten material, and books were examined for marginal notes. Many of the figures of the food rations presented in the table are nevertheless indelibly burned into the memories of those interned at the camp and others are from a source "believed to be reliable."

Average Ration (Ounces per day per person)

	Feb.	Mar.	Apr.	May	June 1–28	After June 28
Rice	8.52	6.67	7.52	7.55	7.00	6.00
Flour	.57	2.00	4.50	8.07	7.00	6.00
Sugar	.39	.42	.42	.36	.42	.42
Salt	.19	.21	.21	.34	.42	.42
Peanut Oil	.19	.21	.21	.21	.30	.20
Beans	.69					
Beef	4.18	4.33	4.47	4.91	4.91	4.91
Pork		.33	.06	.15		
Canned Meat	.29	.36	.24	.09		
Fish	.80	.51	.40			
Eggs (Duck)			.20	.12		
Cabbage		1.70	.51			
Carrots			.14	.37		
Turnips		.95				
Beetroot			.16			
Sweet Potatoes		1.56	1.94	2.40		
Tomatoes			.91	.10		
Lettuce		1.67	1.06	.86		
Spinach		1.28	.27			
Also miscellaneous vegetables			2.37	3.52		
Estimated total vegetable		7.16	7.36	7.25	7.00	7.00

In considering the nutritive value of these rations it should be noted that no fruit, either fresh or dry, was issued, and that the weights reported are gross weights, often including material not included on the "as purchased" basis. It was estimated that there was a 40 per cent loss on the meat values reported due to spoilage and inedible portions, and a 20 per cent loss on the vegetables since the weight recorded included roots, dirt, and damaged leaves. The rice lost at least 5 per cent in washing, the sugar and salt 10 per cent in drying, and the gluten content of the flour was only 10 per cent. It was estimated that 1000 calories a day were obtained in February and March, and approximately 2000 calories in May. There were extremely few supplementary rations obtained in the form of gifts and the garden maintained.

As a consequence of this diet, in one group of 50 persons who were forced to consult the physician, each had lost an average of 34.6 pounds. Another group, none of whom had been ill, lost 19.7 pounds per person. Perhaps on the favorable side, blood pressures had decreased an average of 20 per cent, and some internees who had suffered from stomach ulcers and had been on special diets, found to their surprise that they fared well on the high carbohydrate diet.

Beriberi existed in about 30 per cent of the population of the camp, necessitating a special clinic for 200 serious cases. Fortunately a limited supply of thiamine was available for treatment. An unnamed intestinal upset was common among the internees, as well as an increasing number of cases of night blindness. Twenty-eight cases of probable scurvy responded to ascorbic acid treatment. There was one advanced case of pellagra and an acute attack of sprue experienced by the author.

Nevertheless, in the period up to June 29 there were only 10 deaths in the entire internment camp, less than half the normal death rate of that colony. It is too early, however, to decide whether any will suffer permanently from this period of malnutrition. Those less fortunate British and Dutch nationals still remaining at Stanley will continue to be among the sufferers of malnutrition created by war.

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VITAMIN C AND WOUND HEALING

The slow healing of wounds in the general condition called scurvy has been recognized for some time, but whether or not this delayed process was specifically caused by lack of vitamin C was proved only recently. As early as 1937, Lanman and Ingalls (*Ann.*

Surg. **105,** *616* (*1937*)) noted poor repair and improper collagen formation in experimental wounds of scorbutic guinea pigs. In human beings the most definite evidence of a specific relation has come from the experiments of Lund and Crandon (*J. Am. Med. Assn.* **116,** *663* (*1941*)) in which Crandon himself was maintained on a low vitamin C diet for six months. Only after this time, which was three months after the plasma ascorbic acid had fallen to zero, was there an obvious defect in experimental wound healing. This defect was remedied by the intravenous administration of ascorbic acid, with no other change in dietary intake. These findings are of course in accord with the generally recognized function of ascorbic acid as a regulator of the condition of intercellular material.

The foregoing demonstrations of delayed wound healing necessitated, however, the existence of a serious degree of ascorbic acid deficiency. Reports such as those of Hartzell, Winfield, and Irwin (*J. Am. Med. Assn.* **116,** *669* (*1941*)), in which 19 out of 20 cases of postoperative wound disruption showed accompanying low plasma vitamin C values have been contested by other investigators. Certainly much of the disagreement is related to the difficulty of setting up well planned and controlled studies in human beings as well as to diverse opinions on the methods to determine and define "subclinical deficiency." Nevertheless it is within this ill defined group that it is practical to determine whether wound healing is impaired and whether vitamin C therapy is sound medical practice. Two recent papers add much to our knowledge in this field; the first a fundamental and carefully controlled study on animals, and the second a clinical study employing a careful evaluation of the vitamin C nutritional status at the time of surgical operation.

The animal studies of Bartlett, Jones, and Ryan (*New Engl. J. Med.* **226,** *469* (*1942*)) consisted of two parts: first, assays of abdominal tissue concentrations of ascorbic acid before (control biopsy) and at varying periods following the incision and repair of a midline abdominal wound in guinea pigs maintained on different levels of vitamin C intake; and, second, a comparison of the tensile strength of the healing wounds of two groups of animals, one of which was vitamin C deficient and the other saturated with the vitamin.

Preliminary studies showed that two weeks' maintenance on a given diet was sufficient to establish steady tissue levels of ascorbic acid characteristic of the particular intake, and this control period was always used before the control biopsy.

Tissue biopsies of animals on scorbutic diets, taken both preoperatively and four to fourteen days postoperatively, showed low levels of ascorbic acid. In general, the time of postoperative sampling did not affect the tissue level in any of the groups of animals studied. In the 10 animals on the deficient diet, the average control tissue content of ascorbic acid was 0.25 mg. per 100 g. of tissue, while after operation the average vitamin content of the scar tissue was 0.29 mg. Surrounding tissues showed somewhat lower values than the control biopsies. In distinct contrast the animals maintained on a high vitamin C diet clearly showed a mobilization of the vitamin in the healing area. In these animals the abdominal scar tissue contained an average of 6.53 mg. ascorbic acid per 100 g. of tissue as compared to biopsy controls of 1.57 mg. The adjacent area of the abdominal wall contained 3.13 mg. and the distant abdominal wall, 2.7 mg.

The vitamin C content of the postoperative diet, rather than the preoperative, appeared to be the important factor in establishing the postoperative tissue levels. Thus animals fed a scorbutic diet after operation showed low tissue vitamin levels whether or not they had previously been on a high ascorbic acid diet, and those fed a high vitamin C diet postoperatively showed high levels irrespective of preoperative diet. Since animals initially on a high vitamin C

intake received really massive doses (66 mg. daily), it is obvious that the body stores of ascorbic acid in the guinea pig are rapidly depleted following the operative procedure employed.

The second part of the report of Bartlett and his co-workers clearly demonstrates a marked difference in the tensile strength of the healing wounds of the vitamin C deficient animals and those saturated with the vitamin. The tensile strength was determined by inflating the peritoneal cavity with air (ten days after operation) and recording, in millimeters of mercury, the pressure necessary to burst the wound. The average pressure needed to cause skin separation in the scorbutic guinea pigs was 70 mm. while in the vitamin C saturated animals it was 140 mm. The pressures necessary to cause complete rupture of the wound were 127 and 258 mm., respectively.

It was of interest to note that animals on the "basal" diet, which had maintained apparently healthy guinea pigs over a period of years, possessed tissue levels of ascorbic acid only slightly higher than those on the scorbutic diet and only one-fourth as high as those on the high vitamin C diet. The results illustrate again that the amount of ascorbic acid necessary simply to prevent scurvy may be much less than that required for optimum function—in this case, wound healing.

The clinical study by Lund (*New Engl. J. Med.* **227,** *247 (1942)*) involved a study of 43 patients (48 operations) who were operated upon for gastric lesions. Their nutritional status with respect to vitamin C was determined by dietary histories, blood plasma studies, estimation of white blood cell content, and saturation tests.

Dietary calculations were based on the average intake for the month previous to the first blood test. The accuracy of the information which this procedure yielded depended on whether or not the patients were hospitalized for the month or kept accurate records of their diets (which were probably restricted if they all had gastric lesions). It has been the almost universal experience of nutritionists trained in dietary survey work that the average person cannot describe his diet in detail for more than a few days before questioning. The estimation of vitamin C intake is further complicated by the quality of the foods, their preparative treatment, and their seasonal variation in vitamin content. Actually, remarkably good correlation was reported between the estimated dietary intake and blood plasma levels of ascorbic acid.

Lund has added his experience to that of others in finding that a fasting low plasma vitamin C level is not necessarily indicative of a low tissue reserve. He therefore employed the following type of tolerance test: daily doses of 1 g. of ascorbic acid were given and daily fasting determinations of the blood plasma level were made. A value of 75 per cent reserve was recorded if the plasma level was 1.0 mg. per 100 ml. on the morning after the first 1 g. dose of vitamin C. This might occur even if the original fasting level were much lower, and this finding is interpreted as indicating an adequate tissue reserve in spite of original fasting levels. On the other hand if the fasting level was still 0.0 mg. after three daily doses, the reserve was recorded as 0. Other results fell into intermediate levels depending on the time necessary for the plasma level to rise after such daily doses of the vitamin. It is not possible to determine, from the data presented, how many of the subjects actually received such tolerance tests.

Only 7 of the 43 patients had a daily intake of more than 50 mg. of vitamin C, while an intake of less than 10 mg. was recorded in 16 instances. In 30 cases where fasting plasma determinations were performed, levels greater than 0.6 mg. per 100 ml. were found in only 4 instances, and levels less than 0.10 mg. per 100 ml. were found in 10 cases. Marked disagreement between plasma ascorbic acid levels and dietary records occurred in only 3 cases, in each case the

plasma levels being higher than was anticipated from dietary records. These findings in a group of patients with gastric lesions cannot, however, be considered to be representative of a more general group.

The cases were divided into three groups according to operation: 18 nonradical operations for gastric and duodenal ulcers; 15 sutures of a ruptured gastric or duodenal ulcer; and 15 radical operations for gastric or duodenal ulcer. The groups were further subdivided according to the per cent of vitamin C reserve at the time of healing. Nonradical operations were performed in 8 cases where the reserve was less than 20 per cent, with 3 deaths and one nonfatal complication, a morbidity of 50 per cent. In 15 cases with reserves between 25 and 50 per cent there were 3 deaths and 3 nonfatal complications, a morbidity of 40 per cent. In 10 cases with reserves of more than 55 per cent, there was only one death, a morbidity of 10 per cent. In a group of 6 patients who received vitamin C therapy prior to operation or up to four days after operation (reserves 100 per cent), there were no fatalities or complications. The author concludes that "when nonradical operations were performed, more complications and deaths occurred in the patients with low reserves than in those with high reserves."

The number of cases in these groups is of course small, and subdivisions according to vitamin C reserve may not be the only factor responsible for the differences noted. Larger groups of cases would of course be desirable; on the other hand statistical treatment of a large number would almost certainly suffer from an inadequate evaluation of the nutritional status of the individuals. Lund's results are at least strongly suggestive of a relationship between the vitamin C reserves and the nature of the postoperative course.

No correlation could be found between the vitamin C reserves and the morbidity in those subjects who had radical operations performed. Lund considers that in this type of operation, the marked variations in the medical aspects of the case and the greater chance of technical difficulties are more likely to determine complications.

In 13 subjects with dietary records the initial plasma values were determined only after operation. As contrasted to the better agreement in the larger series considered preoperatively, 4 of these 13 showed decidedly lower plasma levels than might have been expected from the dietary histories. This finding may indicate the rapid depletion of body stores of vitamin C during the operative and immediate postoperative period.

The results of these animal and human studies strongly confirm the need of adequate vitamin C nutrition and vitamin C therapy, particularly postoperatively, in surgical procedures.

THIAMINE DEFICIENCY IN ALCOHOLISM

The polyneuropathy or multiple nerve disorder and other signs of thiamine deficiency commonly seen in the chronic alcoholic have been variously ascribed to (a) insufficient intake of thiamine due to the abnormal dietary habits of these individuals, (b) faulty absorption of the vitamin, and (c) increased requirement of thiamine because of its assumed role as a necessary catalyst in the metabolism of the alcohol. Possibly all three factors play a part in the production of thiamine deficiency as seen clinically in alcoholics. Several studies have shown that patients suffering from "alcoholic" polyneuritis consume diets inadequate in various members of the vitamin B-complex. Jolliffe and co-workers in New York also concluded that thiamine deficiency rather than the toxic effect of alcohol *per se* was the cause of the polyneuritis. The symptoms could be

cured by administration of vitamin B-complex. Strauss, in Boston, allowed patients with alcoholic polyneuritis to continue their usual daily intake of alcohol but they were given in addition a well balanced, high-vitamin diet supplemented with yeast and liver extract. Improvement of the polyneuritis occurred, presumably due to the greater intake of thiamine, although the increased intake of other vitamins in the B-complex may have been involved.

Since the oxidation of alcohol yields a considerable amount of energy, a quart of whiskey supplying some 2800 calories, it has been concluded by many investigators that alcohol requires thiamine to be metabolized. This conclusion was drawn in large part by comparison with the well established fact that an increased consumption of carbohydrate raises the thiamine requirement. In the case of carbohydrate oxidation the fact is established that the metabolism of an intermediate product, pyruvic acid, requires thiamine diphosphate as a component of the enzyme system involved. It has been recognized for some time that biological catalysts are "spent" or undergo a "wear and tear" action during their work. The thiamine "sparing" action of fat which may replace carbohydrate in a diet indicates that fat does not require thiamine to such an extent in its metabolism. The intermediate steps of alcohol oxidation are not conclusively known, however, and the role of thiamine in this process has been largely an assumption.

Westerfeld, Stotz, and Berg (*J. Biol. Chem.* **144,** *657 (1942)*) have recently shown that administration of pyruvate greatly accelerates the oxidation of alcohol in the dog. This action was ascribed at least in part to a condensation of the acetaldehyde, resulting from alcohol oxidation, with pyruvate. Such a condensation is effected by an enzyme which contains thiamine as an essential component. This finding gives more solid support to the thesis that a high alcohol diet necessitates a high thiamine requirement. Incidentally, the oxidation of alcohol to acetaldehyde requires a nicotinic acid-containing enzyme, which offers a parallel argument for the high incidence of pellagra in chronic alcoholism. The authors offer the suggestion that "the chronic alcoholic maintains a high requirement for nicotinamide and thiamine because of the utilization of these vitamins in the metabolism of the alcohol, but he actually derives a large part of his daily calories from vitamin-free alcohol."

Clinical studies have not shown however, that the requirement of thiamine is actually greater than that on a normal diet, but only that the thiamine intake in patients with "alcoholic polyneuritis" is insufficient. The findings of Westerfeld *et al.* show only that alcohol metabolism requires thiamine, but do not indicate whether a calorie derived from alcohol requires more or less thiamine than one derived from carbohydrate. Their work provides an explanation of the apparent anomaly that alcohol "spares" carbohydrate in spite of requiring a carbohydrate derivative (pyruvate) in its metabolism. This is presumably due to the fact that alcohol may supply the equivalent of a half molecule of carbohydrate for further energy-yielding reactions.

In contrast to the above point of view, a recent paper by Lowry, Sebrell, Daft, and Ashburn (*J. Nutrition* **24,** *73 (1942)*) indicates that ingestion of alcohol may decrease the thiamine requirement. They showed, using large numbers of rats, that the ingestion of alcohol or whiskey delays the onset of polyneuropathy and death in animals fed a thiamine deficient diet. This was true whether the alcohol replaced carbohydrate isocalorically or was in addition to the usual diet.

At the present time, therefore, the tentative conclusion may be reached that although the chronic alcoholic requires thiamine for the combustion of alcohol, the requirement may be less than that necessary on the usual diet; but in spite of this safety

factor, the alcoholic who develops polyneuritis consumes so little thiamine-containing food that the intake is generally insufficient to meet the requirement.

THE VITAMIN CONTENTS OF BLOOD AND URINE AS DIAGNOSTIC AIDS

Reasonably reliable chemical methods have been developed for the determination of the better known vitamins in body fluids and excretions: carotene and vitamin A, thiamine, riboflavin, ascorbic acid, and niacin. There also exist extremely sensitive biological or biochemical methods for the quantitative estimation of riboflavin, pyridoxine, pantothenic acid, p-aminobenzoic acid, cocarboxylase and its dietary precursor thiamine, and coenzymes I and II and their dietary precursor niacin. Clinicians, generally, hoped that the discovery of methods for the determination of the vitamin content of blood and urine might place in their hands a tool with which they could detect a vitamin deficiency and diagnose malnutrition before the onset of characteristic clinical signs and symptoms. For a number of reasons, their hopes have not been nearly realized. Nor does it seem that they will be completely satisfied in the near future. Laboratory methods cannot yet replace careful dietary histories or painstaking physical diagnoses; they must be used in a confirmatory sense or in exploratory tests.

Salter has recently reviewed the chemical methods for the 5 vitamins mentioned first above (*New Engl. J. Med.* **226,** *649, 688 (1942)*). He points out that the amount of vitamin A (and carotene) and of ascorbic acid found in blood serum may fluctuate widely, reflecting the dietary content of these substances. The same is true of the niacin content of the serum and probably also of thiamine and riboflavin. However, the amount of these last two substances in the serum is normally so small that variations cannot accurately be measured. The opposite is true of the blood cell content of those vitamins for which it has been determined: ascorbic acid, thiamine (cocarboxylase), riboflavin (flavin-adenine dinucleotide), and niacin (coenzymes I and II). The blood cell content of these substances tends to remain normal until after deficiency disease becomes clinically evident.

The amount of the vitamins excreted in the urine is, except in the case of vitamin A, a fairly direct reflection of the serum content and of the dietary intake. Vitamin A does not ordinarily pass through the kidney into the urine, though in pregnancy there may be an exception; likewise, the urine may contain vitamin A in cases of infectious disease, liver lesions, malignant tumors, and diabetic ketosis.

Although single determinations of individual vitamins in the blood serum and urine in individuals are of limited value as diagnostic aids, consistently abnormal findings on repeated determinations, made under standard conditions, are indicative of tissue desaturation. Measurement of vitamin A and of ascorbic acid in the blood serum has proved to be a reliable procedure for use in nutrition surveys of population groups. More elaborate methods for the detection of tissue desaturation do not readily lend themselves to such studies. Furthermore, when a large proportion of a population group of 500 or more subjects shows abnormally low serum values for a vitamin, it is reasonable to assume that low dietary intakes of that vitamin are prevalent within the group.

Salter highly recommends the "vitamin-tolerance tests" for the detection of tissue undersaturation in individual subjects. Here, a known amount of vitamin is administered and the quantity excreted in the urine subsequently determined. The theory is that "if the tissues have been hungry for

vitamins, they will retain a large portion of the vitamin administered." Dr. Salter indicates several of the difficulties inherent in such tests, pointing out "that it is easier technically to rule out vitamin deficiency than to verify it, and that whenever such a test reveals vitamin deficiency, the technic must be scrutinized carefully and the test repeated, to exclude so far as possible, technical errors . . ."

VITAMIN K AND HEMORRHAGE DURING BIRTH

During the past few years there has been widespread interest in the appraisal of vitamin K as a therapeutic agent to prevent hemorrhage in the newborn infant. It is known that the plasma prothrombin levels of infants at birth are only 15 to 40 per cent of normal adult values, and that they become further decreased during the first few days of life. There is agreement that hemorrhagic disease of the newborn is caused by this prothrombin deficiency, and that it can be corrected if vitamin K is given to the infant or prevented if administered to the mother before delivery. Furthermore, the plasma prothrombin level of infants at birth can be raised by the administration of vitamin K to the mother during labor. These facts have been established. But will the production of higher prothrombin levels in the fetus prevent birth injuries caused or complicated by hemorrhage? This is the question obstetricians are now trying to answer. Of the 128,000 infants born each year who do not survive, 20 to 40 per cent show evidence of cerebral hemorrhage. In some of these, there is injury to large vessels and it is not to be expected that an improvement in the clotting mechanism would lessen the hemorrhage under these circumstances. However, in many other instances oozing occurs from multiple bleeding points, and more efficient hemostasis might conceivably prevent some of the bleeding into tissues. It will take years to accumulate enough evidence to provide a final answer to the question. The few careful studies already reported are admittedly inconclusive. They should, however, be reviewed as the first chapters in the appraisal which can be complete only after four or five more years of observation.

Hellman and Shettles (*South. Med. J.* **35,** *289 (1942)*) gave 2 mg. of 2-methyl-1,4-naphthoquinone by mouth to alternate patients admitted to the delivery floor of the Johns Hopkins Hospital. In both the control and the treated groups there were over a thousand cases. The effectiveness of the vitamin K in raising the prothrombin level of infants at birth is indicated by the following table:

	Prothrombin Dilution Units		
	Mother Prior to Treatment	Mother at Delivery	Infant at Delivery
Average for control group...	—	131	28.6
Average for treated group...	163	203	60.5

There were no detectable ill effects in the mothers as a result of the vitamin K administration. The incidence of retinal hemorrhage was used as an index of the effectiveness of vitamin K therapy in correcting the hemorrhagic tendency. Retinal hemorrhage occurred in 25 per cent of the infants in the control group but in only 15 per cent of the treated group. The investigators felt that failure to achieve a more striking result could be due either to the occurrence of hemorrhages prior to the initiation of therapy during labor, or to the failure of the small amount of vitamin K to elevate sufficiently extremely low infant prothrombin levels. In order to prove this, they gave 50 mothers 2 mg. of 2-methyl-1,4-naphthoquinone daily for four days prior

to the onset of labor. The incidence of retinal hemorrhage in this group was reduced to 4 per cent. Lastly, Hellman and Shettles report that the uncorrected mortality in the treated group was 1.9 per cent while that of the control series was 3.9 per cent. If the figures were corrected by removing all the premature and cesarean section cases, the mortality was 1.2 per cent in the treated and 2.4 per cent in the control group. The difference in both instances is statistically significant.

A similar study has been made by Beck, Taylor, and Colburn (*Am. J. Obst. Gyn.* **41,** *765 (1941)*). Two mg. of 2-methyl-1,4-naphthoquinone were given to alternate mothers in a series of 2059 cases. In the control group 2 per cent of the infants revealed some evidence of hemorrhage while in the infants born of treated mothers only 0.5 per cent showed any signs of bleeding.

A less encouraging experience was reported by Parks and Sweet (*Am. J. Obst. Gyn.* **44,** *433 (1942)*). These workers divided their cases into two groups and to half the mothers gave 5 mg. of 2-methyl-1,4-naphthoquinone orally on admission. They determined that the plasma prothrombin content of cord blood was approximately 20 per cent greater in the treated series. Abnormal bleeding occurred in 1.4 per cent of the 1594 infants in the control group and in 1.7 per cent of the 1151 infants born of mothers who had received the vitamin K. In both groups hemorrhage was observed about three times as often in premature as in full term infants, but the incidence in both treated and control groups was the same. The infant mortality in the control cases was 4.9 per cent, and in the treated series 4.1 per cent. Autopsy studies indicated that hemorrhage, not definitely due to trauma, was associated with approximately 10 per cent of the fetal deaths. These were almost equally divided between the two groups.

The score at present, therefore, is 2 to 1. Two sets of investigators have found that administration of vitamin K to mothers before delivery decreased the incidence of hemorrhage at birth and significantly lowered infant mortality. The third noted no effect from this procedure. Unfortunately the criteria for the diagnosis of hemorrhage are not identical in the several studies. The same objection does not apply to figures about infant mortality. All workers are agreed that vitamin K therapy to mothers during labor raises the plasma prothrombin level of infants at birth.

CAROTENEMIA

It is relatively uncommon outside of the experimental sphere to encounter a frank pathology due to ingestion of an excess of nutritional factors. Education in nutrition, approaching propaganda in some instances, has certainly made at least a part of the population "nutrition conscious." In time of war when variety of foods is limited, this portion of the people might well consume excessive quantities of a food recommended for its high content of vitamins. At least this seems to be an explanation for people consuming 5 to 8 pounds of raw carrots per week for as long as six to eight months. Such data have been reported by Almond and Logan from England (*Brit. Med. J.* **II,** *239 (1942)*). These investigators observed 4 women who showed such a pronounced pigmentation of the skin that tentative diagnoses of pernicious anemia, hemolytic anemia, and jaundice due to cholelithiasis were considered. Careful questioning revealed that all of these patients had consumed the excessive quantities of carrots mentioned. In a fifth patient, a breast-fed infant, the same discoloration was observed, the nursing mother showing the same pigmentation.

This condition does not represent a new

phenomenon. It was observed as early as 1907 in diabetics, who at that time consumed foods rich in lipochrome, a yellow pigment. Normal infants were observed to acquire the skin discoloration when carrots were added to the diet. The color of the skin has been best described as "carroty" and the condition has been termed carotenemia. It was shown in 1913 that the blood of persons with the orange discoloration contained lipochrome pigments spectroscopically identical with those of carrots and other vegetables. The term "xanthemia" has likewise been employed for the circulation of lipochrome pigments in the blood, and "xanthosis" for the obvious presence of these pigments in the skin. Others have employed the term "hyperlipochromia."

In the cases described by Almond and Logan one of the patients had been told that carrots were "full of vitamins." A second grew so many carrots in the garden that they simply had to be consumed; besides, they "left a clean taste in her mouth." A third consumed the carrots to "increase her vitamin intake during her period of gestation." As a result all became "carroty" after a period of several months, although none developed any feeling of ill health other than anxiety over the skin discoloration. During excessive carotene excretion the carotene is apparently absorbed particularly by the horny layer of the skin. Hence concentration of the pigment is observed in the nasolabial folds where sebaceous glands are common and in the palms and soles where cornified skin is thickest. The absence of discoloration in the sclera, a normal blood picture, and the nutritional history constitute the principal basis of differential diagnosis in the clinic. In the laboratory, shaking the serum with alcohol and petroleum ether causes the lipochrome to be concentrated in the petroleum ether fraction, whereas the bilirubin of jaundice is concentrated in the alcohol layer. The cure of carotenemia is effected simply by the removal of the excessive lipochrome-containing vegetables in the diet, though it takes considerable time for the skin to regain its normal color.

There are suggestions that other diseases may predispose to this condition. It has been reported that of many patients, all with abnormal pigmentation of the skin and all with a history of excessive intake of foods rich in lipochrome pigments, carotenemia was present in 10 per cent of these with nephritis and diabetes and in only 3 per cent of the other cases. Infants appear to acquire the condition easily. These reports have been interpreted to suggest a diminished conversion of carotene to vitamin A in the liver of patients with diabetes and a decreased urinary excretion of carotene in patients with nephritis. Carotenemia has also been observed in myxedema, in some cases even when on a normal diet, and it decreases in intensity with thyroid medication. Almond and Logan, in comparing their present cases with those previously reported, state that carotenemia occurs more frequently in patients with diabetes and nephritis than in persons without these diseases.

CHRONIC NUTRITIONAL DEFICIENCIES

The classic nutritional deficiency syndromes, both in man and the experimental animal, are those arising from rather severe degrees of undernutrition (in particular essential food factors) of relatively rapid onset. A concept of nutritional deficiency diseases has recently arisen which postulates that, in addition to the well recognized syndromes, there may be a large number and variety of as yet ill defined affections resulting from relatively minor degrees of malnutrition acting over long periods of time. Such

periods in man would be interpreted as being from several years to a lifetime.

Fraser (*Pub. Health Reports* **57**, *959 (1942)*) has reported studies on the effects of chronic deficiencies in vitamin C, calcium, and both calcium and vitamin C in monkeys which should stimulate further research along this line. Of the 8 monkeys carried by Fraser on a calcium deficient diet, either alone or associated with a low intake of vitamin C, 6 were sacrificed after eleven months and 2 after eighteen months, periods which would correspond to thirty-three and fifty-four months respectively in the life span of man. Eight other animals received the low allowance of vitamin C either alone or in association with a low calcium intake for seven months (equivalent to twenty-one months in the life of man) and were then placed on a diet to produce a complete deficiency. It would have been a more effective test of chronic deficiency if the monkeys had been permitted to live out their natural live span in a state of partial, chronic nutritional deficiency.

The calcium deficient diets contained 10.2 mg. of calcium per 100 g. of ration (control diets, 190 mg. per 100 g.) and the vitamin C deficient diets contained 1.96 mg. or less of vitamin C (control, 30 mg. per 100 g.). The vitamin C deficient monkeys received a supplement of 3 mg. of vitamin C for five days and 6 mg. for one day each week during the first three months and 3 mg. three times a week during the second four months of the period of chronic depletion.

No animal on the calcium deficiency regime showed any symptoms before ten months. Shortly after this, one monkey showed a moderately rapid decline in weight. Of the 2 monkeys continued longer than eleven months, one began to lose weight after four hundred and eighty-eight days and in five hundred and twenty-one days developed diarrhea, increased irritability, reduced activity, muscle atrophy, and loss of muscle tone. The other started to lose weight in four hundred and thirty-two days at which time it showed symptoms of irritability. One month later it developed anorexia and, after four hundred and seventy-five days, a considerable weakness of the hind legs (first definite sign). Subsequently there was muscle atrophy and loss of muscle tone, and the fur became stringy.

Only one of the 8 animals on the low vitamin C intake, either alone or in combination with a low calcium intake, showed "conspicuous symptoms" of vitamin C depletion in the seven month period. This large, rapidly growing animal (weight 5.2 kg. and gaining 2.5 kg. in the first seven months of the experiment) developed a gingivitis in one month on a vitamin C intake of 3 mg. daily. One week later this was associated with hemorrhage. The condition cleared up only after therapy with vitamin C. Two of the chronically vitamin C deficient monkeys showed a marked decrease in the mean corpuscular hemoglobin and there was a tendency for all 8 animals to show lower white blood cell counts than comparable controls.

A marked depletion of bone calcium occurred in the monkeys with a chronic calcium deficiency, with or without an associated vitamin C deficiency. There was a considerable depletion of bone calcium in the young monkeys in the vitamin C deficient group but not in the older animals in the same group. The chronic calcium deficient animals showed a drop in serum calcium. In the combined deficiency of calcium and vitamin C, a normal level of blood serum calcium was maintained despite extensive depletion of bone calcium. There was a striking decrease in the serum albumin and an increase in serum globulin in the vitamin C deficient animals. The total protein content of the blood serum remained within normal limits.

Following complete withdrawal of vitamin C from the diet all of the animals developed scurvy in from twenty-one to forty-four days. The author concludes: "There was

no evidence that a chronic deficiency of both calcium and vitamin C influenced the course of these animals other than what might be anticipated from an addition of their individual effects." The mouth lesions demonstrated by the vitamin C deficient monkeys are described in a separate article by Fraser and Topping (*Pub. Health Reports* **57,** *968 (1942)*).

Fraser's work indicates the inadvisability of drawing negative conclusions from short term studies on the effects of partial deficiencies upon both animals and man. It also demonstrates our need for more reliable diagnostic methods for early and slight degrees of malnutrition. The paramount lesson to be learned from this and similar studies, however, might be said to be that, in the light of our present knowledge of malnutrition, the "good" diet is that which provides the optimum intake of all the essential food factors.

PERNICIOUS ANEMIA AND VITAMIN C

A provocative report of the successful treatment of pernicious anemia patients with ascorbic acid, when liver therapy alone failed to elicit a response, has been presented by Dyke, Della Vida, and Delikat (*Lancet* **II,** *278 (1942)*). Ever since Minot and Murphy in 1925 first reported the successful remission of that hitherto incurable disease by the feeding of large amounts of liver it has been recognized that it is important to treat concomitant dietary deficiencies in order to obtain successful results. Thus the administration of iron salts may be necessary, along with the feeding of liver or the injection of potent commercial preparations of liver extract, because iron is needed for the production of hemoglobin and some patients may not have suitable reserves of this element. Protein is another important factor and, in general, it is becoming recognized that along with adequate therapy pernicious anemia patients may need specific instructions in the art of selecting an adequate diet. The present report emphasizes the necessity of giving special attention to the dietary intake of vitamin C.

The evidence provided by the British investigators is limited but clearcut. One of their case reports may be cited as an example. A 67 year old woman showed, on admission to the hospital, the signs and symptoms typical of pernicious anemia. The hemoglobin content of the blood was just half normal and the red cell count was 1.65 million cells per c.mm. of blood, which is approximately one-third the normal value. As is usual in such cases the red cells were larger than normal. The number of reticulocytes was abnormally small. The results of other tests such as a negative Van den Bergh reaction of the blood serum and the lack of free hydrochloric acid in the gastric secretion also were typical of pernicious anemia. This patient was given potent preparations of liver extract for nine days, with no response. Beginning on the ninth day 300 mg. of ascorbic acid were also administered daily for eight days, after which the dosage was reduced to 150 mg. Within five days after the administration of vitamin C the reticulocyte count had reached a peak and within a few days more there was a rise in both red cell count and in hemoglobin concentration. A month after discharge from the hospital the blood picture showed a hemoglobin content of 73 per cent of normal, and a red cell count of 3.84 million cells, which is a fairly good response.

The investigators point out that the patients were under observation during the spring of 1942. There is other evidence which indicates that the vitamin C content of the general diet in Great Britain at this particular time was low. The fact that the administration of vitamin C was effective

thus appears to have a rational basis, but it still leaves many problems for solution.

Physicians who have treated pernicious anemia for long periods have been impressed by the seasonal variations in the effective dosage of liver extract that is necessary for proper maintenance of each patient. Beginning with the end of February, or perhaps early in March, many pernicious anemia patients show a deterioration in their blood picture and an aggravation of their symptoms. As a rule good response is effected by the administration of larger amounts of liver extract. Manufacturers of commercial liver preparations for the treatment of pernicious anemia know that the demand for products is increased several fold during the spring months, and is continued until July.

The British investigators further report that with a number of patients (the details are not given) the usual maintenance dosage of liver was allowed to remain unchanged and 100 mg. of ascorbic acid were administered. All these patients are said to have shown a rapid increase in blood count and corresponding improvement in general health after treatment for a month. The application of such observations in the treatment of pernicious anemia or in the testing of the potency of commercial products is obvious. But first it will be necessary to obtain additional careful records of observations on patients. It would be of interest to know the vitamin C intake of patients at various times of the year and to know whether the seasonal variation of vitamin C of the diet is sufficient to bring the intake of some people below the requirements during the spring months. Furthermore, the vitamin C requirements of patients with pernicious anemia compared to those of healthy persons should be established. It would be of interest to examine the blood of pernicious anemia patients for the amount of ascorbic acid in the serum. Perhaps these and other suggestions that readily come to mind can be investigated during the spring of 1943 when, according to all available information, there should be sufficient clinical material for detailed study. An insight into the mechanisms involved, such as might be obtained through careful research, may lead to further applications that cannot now be anticipated.

THIAMINE DEFICIENCY IN DIABETIC RATS

Some clinical observers have claimed that thiamine is a useful adjunct to insulin in the treatment of diabetes in man, but these reports have not stood the test of reexamination. Others have seemed to partially confirm these observations by noting apparent intensification of diabetes in depancreatized dogs subsisting on a so-called vitamin B-free diet. Other evidence, with rats as experimental subjects, has indicated that glucose tolerance is not affected by the presence or absence of thiamine in the diet.

Styron, Tucker, Rhodes, Smith, and Marble (*Proc. Soc. Exp. Biol. Med.* **50,** *242 (1942)*) have endeavored to shed further light on the problem by studying the effect of thiamine deprivation on depancreatized rats. It was hoped, also, that the experiments might give some indication of the role of thiamine in peripheral neuritis which is sometimes encountered in patients afflicted with severe diabetes. Clinically, the peripheral neuritis picture is comparable to that observed occasionally in alcoholism and pregnancy. It is recognized that thiamine deficiency results in disturbed carbohydrate metabolism, with an accompanying accumulation of pyruvic and lactic acids in the tissues.

Male rats, 3 to 10 months of age, were used. These animals had been depancreatized when they were 27 to 37 days old.

Diabetes was proved by blood sugar levels and glucose tolerance tests. Prior to the experiments the animals had been maintained on a stock diet supplemented with raw beef pancreas.

The experimental diet consisted, in parts per 100, of sucrose 53, casein 35, Crisco 5, cod liver oil 2, and salt mixture 5. Glucose tolerance tests were made after fasting and one-half, one, two, three, and five hours after the intraperitoneal injection of 0.35 g. of glucose per 100 g. body weight. Blood from the tail was used for blood sugar determinations. Diabetic and nondiabetic rats received the purified diet for three to four weeks, supplemented daily with thiamine, riboflavin, autoclaved rice polish concentrate, and choline. At the end of this time glucose tolerance tests were made, after which thiamine was removed from the diet but the other supplements were continued.

Ten days after thiamine had been removed from the diet, animals began to show loss of appetite and body weight, and polyneuritic symptoms for both groups occurred in about forty days. No significant correlation between time for development of thiamine deficiency symptoms and severity of diabetes could be noted. Glucose tolerance tests on diabetic and nondiabetic rats deprived of thiamine yielded no significant differences. Furthermore, nondiabetic rats showed no advantage over diabetic rats so far as recovery from thiamine deficiency was concerned. When relatively large doses of thiamine were administered to diabetic and nondiabetic thiamine deficient animals, some improvement in glucose tolerance could be noted in both groups. During the deprivation period, accompanied by lowered food intake, urinary sugar tended to diminish but returned to the usual level when thiamine deficiency was most marked. Glucose tolerance also showed little impairment until definite symptoms of thiamine deficiency appeared.

These experiments do not support the contention that thiamine is of value in the treatment of diabetes *per se*.

REMOVAL OF FLUORINE FROM SKELETAL STRUCTURES

Fluorine is one of the elements belonging to the halogen group but unlike iodine and chlorine it has never been demonstrated to be an essential dietary constituent. On the other hand, the element is present in minute quantities in common foodstuffs and it has been demonstrated that the ingestion of additional small daily quantities causes chronic fluorine toxicosis, or fluorosis in animals and man. Human beings exposed to dusts from factories employing fluorine-carrying chemicals invariably develop fluorosis. Fluorine compounds readily undergo chemical reaction with the calcium phosphates and for this reason it is found concentrated in such skeletal structures as the bones and teeth.

Many important facts have been learned about the toxicity and physiological properties of the element. However American investigators have demonstrated repeatedly during the past decade that fluorine is a cumulative element in the bones with advance in age, that skeletal structures under average conditions contain normally about 500 p.p.m. of fluorine, and that long-continued ingestion of fluorine causes chronic fluorosis which results in severe exostosis in the adult and mottled enamel in the young. Water supplies contaminated with more than 1 to 2 p.p.m. of fluorine invariably cause mottled enamel in the deciduous teeth of the young growing child (and frequently cause mottled enamel in the permanent teeth). These teeth are more resistant to dental caries than normal teeth yet their wearing qualities are inferior. Phillips, Hart, and Bohstedt have shown that the

teeth and bones of fluorotic cattle are porous, soft, and lacking in quality in comparison to the teeth and bones of normal cattle.

On the basis of the fact that fluorinated teeth are less subject to dental caries, certain investigators have advocated the use of fluorinated communal drinking waters. This practice is highly questionable in view of the other known physiologic reactions to fluorine. "Poker backs" and loss of reproductive faculties have been reported from certain regions in India where the endemic water supplies were contaminated with fluorine. The "poker backs" were caused by calcification of the vertebral column due to ossification of the cartilaginous pads lying between them. Recently Arnold, Dean, and Elvove (*Pub. Health Reports* **57,** *773 (1942)*) have shown that increasing the fluoride content of a public water supply from 0.1 to 0.7 p.p.m. produced no favorable decrease in the incidence of caries in school children over a two year period, neither did it reduce the *Lactobacillus acidophilus* counts in the saliva. Means of combating established chronic fluorine toxicosis are still sought, although methods of removing fluorine from contaminated water supplies and from calcium-phosphorus mineral supplements have been successfully established.

Glock, Lowater, and Murray (*Biochem. J.* **35,** *1235 (1941)*) report that the fluorine content of bones of human beings has been determined and that skeletal fluoride in the experimental rat can be reduced by diet. These authors attempted to determine the fluorine content of bones of human beings at different ages in the absence of signs of fluorosis, and to demonstrate the uptake and elimination of fluorine from fluorine-fed rats. The fluorine content of bones of human beings was studied from birth to 68 years of age, and, in confirmation of earlier reports, a rise was observed in fluorine concentration with increase in age. The fluorine content was within a range of 0.02 to 0.3 per cent.

In another experiment they fed young rats from birth to 84 weeks on a diet containing only 4.7 p.p.m. of fluorine. The rats were divided into two groups, one of which received 1 ml. of 0.05 per cent sodium fluoride per gram of ration while the other served as the control. At different ages control rats and fluorine-fed rats were killed and the long bones analyzed for fluorine. Analyses were made both spectrographically and chemically. Again these investigators demonstrated that fluorine accumulated in the long bones of the rat with increasing age. Rats fed the control diet increased the fluorine content of their long bones only from 190 to 280 p.p.m. in 84 weeks. During a similar interval the rats which were fed sodium fluoride increased from an average of 190 to 7050 p.p.m. of fluorine in the long bones. A progressive increase in fluorine concentration in the long bones occurred from 2 to 84 weeks, respectively. If rats which were fed sodium fluoride for 32 or 40 weeks were allowed to continue on the basal diet without added sodium fluoride, a drop in fluorine concentration from 9430 to 3020 and from 6000 to 2870 p.p.m. of fluorine was noted. The authors conclude that the feeding of small amounts of fluorine to the rat results in a fluorine uptake in the long bones which follows a logarithmic curve, and that withdrawal of fluorine from the diet results in the elimination of fluorine.

These results do indicate a loss of fluorine from the bones but they should be considered with respect to other findings. Evans and Phillips fed a 0.05 per cent sodium fluoride diet to growing and adult rats for six weeks and were unable to obtain a progressive elimination of fluorine from the femur and tibia after the thirteenth week following transfer to a low fluorine diet containing only 1 to 2 p.p.m. of fluorine. No appreciable loss in fluorine concentration occurred between the thirteenth and twentieth weeks. The bone fluoride at the beginning of the experiments was only 3286 p.p.m., which contrasts sharply with the values reported

by Glock *et al.* At the end of twenty-one weeks the fluorine concentration had reached a level of 1626 p.p.m. and had remained nearly constant since the ninth week. If the rats were placed on a low fluorine diet that was also low in calcium and phosphorus for nine weeks, the loss of fluorine was of the same order as that obtained in the low fluorine diet alone. Evans and Phillips data suggest that a fraction of the fluorine deposited in the long bones may be removed readily by eliminating the dietary fluorine but that a residual fluorine concentration several times the normal persists even in the face of continued feeding of a diet low in fluorine.

The hope of completely eliminating fluorine from the body in cases of chronic fluorosis is therefore extremely remote according to present knowledge. The concentration of fluorine in the long bones of experimental animals is rather consistent for all laboratory animals studied thus far when subjected to chronic fluorosis. Phillips, Hart, and Bohstedt presented ample evidence to indicate that cattle showing minor symptoms of fluorosis had femurs with more than 5000 p.p.m. of fluorine. Glock *et al.* may be safe in assuming that a concentration of only 3000 p.p.m. of fluorine in the long bones of the rat represents a safe level of skeletal fluorine but this is five to ten times the concentration normally found in the rat raised on a normal diet. It still remains to be seen whether the fluorine content of the long bones can eventually be reduced to normal or even noninjurious levels after exposure to abnormally high intakes of fluorine.

Fluorine has been shown to interfere with carbohydrate catabolism in the living cell. The substitution of fluorine for iodine in certain of the compounds indigenous to the thyroid gland, and indeed thyroxine itself, profoundly affects the physiologic reactions of these compounds. Exostosis of the skeletal structures, early and rapid abrasion of the teeth, and consistent degenerative changes in some of the internal organs are reactions which must likewise be kept in mind in considering the therapeutic use of fluorine for the control of dental caries. At the present time the ingestion of fluorine must be viewed conservatively and until such time as it can be demonstrated that its ingestion will be counteracted or the quantities successfully eliminated, the smaller the intake the better. Evans and Phillips have shown that successful growth, well-being, and reproduction could be maintained in the rat on intakes of as low as 0.1 to 0.2 p.p.m. of fluorine. These experiments suggest that minimal trace levels of fluorine must meet the requirements if indeed any need exists.

NUTRITIONAL STATUS OF GREAT BRITAIN

According to addresses made recently by Sir John Boyd Orr in this country the food situation in Great Britain now is on a reasonably satisfactory basis. What may be called an iron ration is being consumed, with practically all luxury foods eliminated, but it is ascertained that the diet is nutritionally as good as it was under peacetime conditions. More fresh vegetables are being grown for home consumption, with emphasis on carrots, cabbage, and greens. British scientists have cooperated in studies of the soil with a view to making use of every available portion of arable land, and fields on which crops had not been grown for years have been treated with appropriate fertilizers so that they would be productive. Entomologists have made surveys of destructive insects such as cutworms, and soils which are heavily infested are planted only with the types of crops which those insects do not harm. The food that is imported is wisely used with the

nutritional viewpoint being given prime consideration. Wheat is ground to meet the government specifications for national wheat meal of 85 per cent extraction in order to use more of the grain and to obtain its best nutrients for making breadstuffs. Among the farm animals, which compete with man for food, the dairy cow and the laying hen receive priority ratings because of the high efficiency of the cow for converting feeds into food for man and because of the need for fresh milk and eggs. Since early in 1942 all babies and expectant mothers are receiving cod liver oil and orange juice by government action. It is Sir John's impression that many of the poor children are actually in better nutritive condition now than children in similar circumstances were before the war.

Such reports are encouraging, but there is reason to believe that it would be prudent to avoid overly optimistic conclusions until the evidence becomes available in such form as to permit independent interpretation of the data. Certainly constant vigilance will need to be given to the food situation by experts in nutrition.

A number of recent reports in the Lancet show that the vitamin C supply of the diet still remains one of the weak points. Harris made a study of the vitamin C levels of school children and students (*Lancet* **I,** *642 (1942)*) and Francis and Wormall made a study of medical students (*Lancet* **I,** *647 (1942)*). These investigators emphasize the need for care in securing an adequate amount of vitamin C, especially in the winter and early spring.

In the study reported by Harris, boys in schools and colleges were examined by means of the so-called saturation test. This procedure now has been adapted so that it can be used in extended nutrition surveys. A test dose consisting of 5 mg. of ascorbic acid for each pound of body weight is made into a palatable drink which is consumed in the middle of the morning. During the afternoon, at a time when the peak of response is usually obtained, the urine is collected over a two-hour period. The vitamin C in this specimen is determined by titration with 2,6-dichlorophenolindophenol. Tests are repeated each day and continued until the amount of vitamin C excreted has reached a more or less constant high level. Experience has shown that the number of days required for this attainment of maximum urinary excretion, which is taken as an indication that the reserves of the subjects are then saturated, is a measure of the body's supply of vitamin C. If a person is in a satisfactory state of vitamin C nutrition, approximate saturation is reached in one day. In patients with fully developed scurvy it may require from seven to ten days before this condition is attained. Harris has provided a critical discussion of the test and has concluded that the method is reliable (*Lancet* **I,** *644 (1942)*).

Of 29 boys in a "poor class elementary school" thus examined in the early spring months of 1941, one became saturated after one day, 4 after two days, 8 after three days, 11 after four days, and the remaining 5 after five or more days. These results may be compared with those obtained with 35 boys examined at the same time of the year in 1938. At that time 10 boys became saturated after one day, 11 after two days, 9 after three days, and the remaining 5 on the fourth and fifth days. A similar decline in the vitamin C status was observed even with boys who received a good institutional diet and who were shown to be in better nutritive condition. Thus, of 33 boys examined early in 1941, none reached saturation after one day, 8 after two days, 21 after three days, 3 after four days, and 1 after five days. In the spring months of 1939, when oranges were included in the diet, 25 of the 29 boys reached saturation in one day, and the remaining 4 on the second day. Conditions were better in all subjects in the autumn months. For example, of 10 boys receiving a good institutional diet examined in the fall of 1941, 9 became saturated after

one day and the tenth after two days. In another group of 10 boys receiving a supplement of 15 mg. of ascorbic acid, all 10 were saturated after one day. Another group of 12 boys received 25 mg. of ascorbic acid daily in addition to the institutional diet and all 12 showed that they were saturated after one day. There is thus evidence of a strong seasonal tide in vitamin C nutrition, as would be expected to follow the rise and fall in the consumption of plant foods which are significant sources of ascorbic acid.

Francis and Wormall tried similar tests on groups of medical students. These examinations were made between May and July, 1939; in July and September, 1940; and in June and July, 1941, twenty-one months after the outbreak of the war. These tests have been reported in a slightly different manner, but it was shown clearly that the groups examined in 1941 were in relatively poorer shape from the vitamin C point of view than were the students previously examined. Thus, of 52 subjects examined more recently, 48 required two or more daily doses; 35, three or more doses; 21, four or more doses; and 11, five or more doses, in order to reach saturation.

Other evidence has indicated that the hemoglobin level of the blood is lower in women and children than it was before the war. There is reason to believe, however, that this condition is not solely the result of a lower intake of iron—indeed the iron intake may be higher now than formerly because of the greater use of less refined cereals —but the protein and vitamin content of the diet may be in part responsible. In a discussion of "Food Production and Distribution," J. D. King commented (*Lancet* **I,** *395* (*1942*)) that he had noticed in some London children ulcerative gingivostomatis (trench mouth) which responded to local treatment supplemented by the administration of nicotinic acid or dried yeast. It may be necessary therefore to give particular attention to the niacin content of the British diet.

At least two articles provide support of the view that the British diet is adequate. Munro, Lazarus, and Bell (*Lancet* **I,** *648* (*1942*)) have used the capillary fragility test in an examination of 182 students in January and February, 1942. The results showed that the vitamin C nutrition was adequate. Further, the distribution curve of the results coincided with another curve obtained in a survey of 346 students in 1937 and 1939. It is generally conceded, however, that the capillary fragility test is not a sensitive measure of the state of vitamin C nutrition, although it does enable one to detect those persons who are markedly deficient in vitamin C. Wilson has examined the condition of vitamin B_1 nutrition in children by the pyruvic acid test (*Lancet* **I,** *199* (*1942*)). The normal value of pyruvic acid in the blood is about 0.7 to 1.3 mg. for each 100 ml. and it is increased in patients with thiamine deficiency or with beriberi. This investigator used Klein's method of determination and found, in 35 children just admitted to the hospital, that the average blood pyruvic acid was 0.99 mg. per 100 ml. with a range from 0.63 to 1.22 mg. This agrees essentially with results of other observations on normal children. Thirty children were examined after they had been in the hospital for surgical treatment, the time being from seven to thirty days after operation. The average amount of pyruvic acid in each 100 ml. of the blood of these patients was 1.05 mg. with a range of 0.54 to 1.36 mg. Normal values were found in patients having infections or other conditions for which hospitalization was required. It is of interest that in 7 children, from whom blood was drawn while under ether anesthesia, lower values were obtained; of course, this may be attributed to the lower rate of dextrose metabolism and the consequent decrease in the production of the intermediate pyruvic acid. The average was 0.67 mg. and the range was 0.54 to 0.91 mg. per 100

ml. of blood. The author concluded that there is no deficiency of vitamin B_1 in the diets of these children.

A major difficulty with all the results discussed in this review is that no calculations have been reported of the dietary intakes. It is thus difficult to interpret the data in terms of foods. While the results of examinations of the nutritive status by means of blood tests and other methods, including the newly developed technics involving the use of the biomicroscope, are important criteria in measuring the adequacy of the diet, the diet itself should be evaluated by the tedious collection of data on the foods consumed and analysis of their composition in terms of the essential nutrients. It may be concluded from the available evidence that the nutritional status of the British people is reasonably satisfactory, except that there may be a deficiency of vitamin C during the winter months and in the early spring.

National dietaries are still being evaluated in terms of foods, their average composition and estimates of the dietary requirements. The British continue to use the old League of Nations standard of 30 mg. daily as the vitamin C requirement for adults. The present recommendation of the Food and Nutrition Board for good nutrition of the adult is 75 mg. What are the minimum requirements below which the vitamin intake should not be permitted to go? Should the diet of special groups, such as children and pregnant women, be supplemented with ascorbic acid or with unusual food products rich in vitamin C during the months when fruits and vegetables are unobtainable? These are some of the questions which a careful dietary analysis, supplemented by tests of vitamin C saturation, would help to solve.

ASCORBIC ACID LOSSES IN PROCESSING GRAPEFRUIT JUICE

If traffic bottlenecks continue to hinder prompt shipment of fresh food products, supplies of fresh fruits may be curtailed in many parts of the country. This may force fruit growers to bend every effort toward the conservation of surplus fruit crops by preserving increasing amounts of fruits and fruit juices in available containers until shipment can be made. If fruit juices are to be consumed in increasing amounts, it is important to know how the canned fruit juices compare in nutritive value with the fresh fruits from which they were made.

Floyd and Fraps (*Food Research* **7**, *382 (1942)*) have made a study of the ascorbic acid content of Texas grapefruit before and after processing by various commercial methods. Large scale processing plants were found to differ in the amount of cull fruit used in preparing grapefruit juice. Furthermore, methods of extracting the juice varied from plant to plant. Some plants use a screw extractor; others use burr head extractors, similar to those used in drugstores and kitchens; some use an automatic extraction process in which the juice is extracted by means of corrugated rollers; still others use a mechanical grater, with screens to separate the juice from seeds and grated pulp.

Juice from fresh, first-grade, tree-ripened grapefruit varied from 38 to 46 mg. of ascorbic acid per 100 g. of juice with an average of 41 mg. Canned fruit juices contained, on the average, 18.2 per cent less ascorbic acid than the fresh juices. Since processing plants differed in the amount of time which elapsed between extraction and pasteurization, studies were made to determine the losses of ascorbic acid due to oxidation. Oxidative destruction amounted to about 6 per cent if 3.5 minutes or less elapsed between extraction and pasteurization. In five minutes the loss was 11.2 per

cent, in twenty minutes 29.6 per cent, and in thirty minutes of tank storage the oxidative destruction amounted to 34.7 per cent.

The authors state that hydrogen sulfide treatment "did not cause any increase in the titratable ascorbic acid" when fresh and canned juices were tested early in the experiment. As a result, the writers state that "hydrogen sulfide treatment was omitted after the first four or five determinations." One is tempted to wonder how much dehydroascorbic acid might have been found if the stored juices had been treated with hydrogen sulfide. This is a matter of some importance since dehydroascorbic acid is readily utilized by the body but is not susceptible to estimation by the dye titration method, unless it is changed to the reduced form by hydrogen sulfide or a similar reducing agent.

Quality of fruit was reported to be important, since canned juice made from fruit containing 10 per cent or less of culls averaged 36.1 mg. per 100 g. of juice as compared with 29.5 mg. per 100 g. when the juice came from fruit consisting of 90 per cent culls. Frozen fruit yielded 31.1 mgs. per 100 g. as compared with 36.0 mg. per 100 g. for unfrozen fruit.

As might be expected, screw extraction and burr (hand reaming) extraction caused greater destruction of ascorbic acid than the other methods described.

TONGUE CHANGES IN NUTRITIONAL DEFICIENCY

Jeghers (*New Engl. J. Med.* **227,** *221, 1942*)) points out that although the "old-time practitioner" obtained much helpful information from the appearance of the patient's tongue, the modern physician can use this simple observation to a much better advantage. Changes in the tongue may reflect many systemic diseases other than nutritional deficiencies. In addition there are many disorders which can be localized in or are peculiar to the tongue, for example, leukoplakia, cancer, chancre, tertiary syphilis, benign tumors, traumatic ulcers, glossitis rhomboidea mediana. These conditions can be readily differentiated from those lingual changes generally accepted as due to nutritional deficiencies (the raspberry tongue of scarlet fever may however closely resemble the magenta glossitis of ariboflavinosis).

The lingual changes in nutritional deficiencies can be better understood if the anatomy of the dorsum of the tongue is reviewed. The dorsal covering of the tongue, anterior to the V-shaped sulcus terminalis of His, is adherent to the muscular tissue and consists of a corium rich in vessels, nerves, and lymphatics covered by stratified squamous epithelium, arranged largely as numerous papillae. Eight to twelve large circumvallate papillae form a V just anterior to the sulcus terminalis. Most of the anterior dorsum is covered with many filiform papillae. The epithelium over these papillae is rather opaque, hiding the underlying vascular bed and thus accounting for the normal whitish-pink color of the tongue. There is a continuous shedding and regeneration of the epithelium of the papillae (some coating of the tongue is therefore a normal occurrence). The epithelium over the fungiform papillae is thinner and more transparent, allowing the underlying vascular bed to show through. These papillae appear as rounded, red eminences, larger but much fewer on the dorsum than at the tip and edge of the tongue. The filiform papillae appear to be the most sensitive to metabolic disorders, and changes in them account largely for the characteristic appearance of the tongue in certain nutritional deficiencies.

Either definitely or probably associated with nutritional deficiencies, according to

Jeghers, are pellagrous glossitis, riboflavin deficiency glossitis, and Hunter's glossitis. The lingual changes in niacin deficiency characteristically begin with swelling and redness of the tip and edges of the tongue. Redness progresses to a fiery scarlet hue which may involve the whole tongue. Patients with pellagrous glossitis usually suffer severe pain. Ulcerations, covered with pearly exudate and teeming with Vincent's organisms are frequent. In the early stages, atrophy of the papillae is not a prominent feature but there may be necrosis of the papillae with increased desquamation, resulting in an excessively coated tongue. In some instances the first manifestation may be merely a painful, swollen tongue showing indentations from the teeth.

As the condition progresses the filiform papillae become atrophied, causing a raw red tongue on which the fungiform papillae may be prominent. There may be loss in substances of the tongue so that the whole tongue is atrophied and smaller than normal. Such smooth tongues are rarely coated as the existence of papillae appears to be essential for the presence of a coat. Following adequate therapy with niacin, the papillae regenerate and the normal coating of the tongue returns.

In the case of riboflavin deficiency glossitis, the tongue is magenta or purplish red. In Dr. Jeghers' words, "the epithelium over the papillae does not desquamate, but appears flattened and edematous, with resultant 'mushroom-shaped' papillae that give the surface of the tongue a finely 'pebbled' or granular appearance. Hence the synonyms—pebbled tongue, granular tongue, and magenta tongue—applied to this form of glossitis. Fissures may develop. The tongue may be painful, may have a burning sensation, and may even cause some dysphagia on swallowing. These lingual changes may precede and almost constantly accompany the cheilosis and seborrheic dermatitis of this deficiency state."

Dr. Jeghers offers an explanation for the magenta color of the tongue: "Capillary dilatation and proliferation are prominent features in ariboflavinosis and undoubtedly take place in the mucosal portion of the papillae. If the capillaries are dilated, one may postulate that the circulation of red corpuscles through them may be slowed. The overlying epithelium is not desquamated but thinned and perhaps edematous. These dilated capillaries, with their stagnant blood flow seen through the changed epithelium, give the resultant magenta color to the tongue. The rapid blanching of the tongue following riboflavin therapy further supports this explanation."

The characteristic tongue of sprue and pernicious anemia, (Hunter's glossitis), is smooth, atrophic, and without coating. The color varies with the degree of anemia present, pallor generally being a prominent characteristic. Pain is seldom if ever as severe as with pellagrous glossitis but complaints of pain, burning, and numbness, particularly when spicy, salty, or hot foods are placed in the mouth, are the rule. The glossitis of sprue has been observed to subside upon treatment with beef muscle, yeast, and liver; that of pernicious anemia with liver and combinations of beef muscle or yeast with sources of the "gastric intrinsic factor." Characteristic clinical cases of pernicious anemia have been seen occasionally to respond to intensive therapy with yeast alone. The evidence appears overwhelming that the glossitis of both pernicious anemia and sprue is a manifestation of a nutritional deficiency disease.

Jeghers describes an atrophic glossitis "not readily recognizable as due to any specific vitamin deficiency . . . to be a common clinical finding." There is nothing distinctive about this atrophic glossitis and it probably represents the final stage of any nutritional deficiency glossitis. Unless the patient shows other diagnostic lesions of a specific deficiency disease, it is often not possible to predict the particular vitamin therapy to which such a glossitis will respond.

Various investigators have described tongue lesions which, although failing to respond to therapy with niacin or riboflavin, have responded to other members of the B-complex (e.g. vitamin B_6) or to treatment with the whole complex. The descriptions of such tongues have not been clear enough to allow clinical differentiation before therapy. Lingual changes have also been noted in iron deficiency.

Listed by Jeghers as definitely not due to nutritional deficiency disease are geographic tongue (wandering rash), grooved tongue (scrotal tongue), and black (hairy) tongue. All these are chronic but relatively benign conditions generally requiring no therapy, but occasionally failing to respond to any type of therapy.

He suggests the following simple classification, into which the vast majority of tongues would fall:

Normal tongue
Coated tongue
Grooved (scrotal) tongue—with a coat, with macroglossia, with wandering rash, or with atrophy
Pellagrous glossitis
Riboflavin deficiency glossitis (magenta tongue)
Atrophic glossitis—with complete smoothing, slight general smoothing, or marginal smoothing
Geographic tongue (wandering rash)
Black (hairy) tongue

"With salivation or dryness, with ulcerations or fissures and with microglossia or macroglossia can be added . . ., if necessary." Color, or degree of redness or pallor, might also be added as a supplemental description.

Such a classification has definite value both in clarifying lingual conditions in the minds of practitioners and research workers, and in bringing about a standard nomenclature in the literature. The separate listing of normal and coated tongues does, however, imply that a coated tongue is not a normal one, whereas some coating is in fact a normal feature. The substitution of "excessively coated tongue" for "coated tongue" as the second item in the list is desirable.

Many competent clinicians maintain that it is not possible to differentiate the glossitis due to niacin and riboflavin deficiency, and Dr. Jeghers warns against the diagnosis of pellagrous or riboflavin deficiency glossitis in the absence of other specific lesions or unless the tongue changes are unusually characteristic. This, of course, in no way denies the advisability of instituting appropriate therapy whenever the existence of either of these two conditions is suspected.

DEFICIENCY STATES AND THE BIOMICROSCOPE

There is an apparent discrepancy between dietary inadequacies as revealed by surveys and the occurrence of deficiency disease as noted by clinicians. Some of this discrepancy is undoubtedly due to the high standards of "adequacy" adopted in some surveys; a large part is undoubtedly due to the lack of criteria to diagnose mild deficiency. It is generally conceded that there must be many cases of mild or early deficiency states, the so-called latent or subclinical deficiencies, which cannot be detected by the usual clinical methods.

In recent articles, Kruse (*Milbank Memorial Fund Quart.* **20,** *245, 262, 290 (1942)*) offers "A Concept of the Deficiency States" and describes the use of the biomicroscope and careful visual examination in detecting early niacin deficiency by pathology of the tongue and ascorbic acid deficiency by pathology of the gums.

Kruse's concept is that "in a deficiency disease the specific pathological process in a tissue is characterized by velocity, intensity, and sequence." An acute process is rapid in its course and also rapid in responding to

therapy. A chronic process is slow in its onset, progress, and in response to therapy. Both the acute and chronic states may be divided into mild and severe degrees. The "mild" state is generally of such low intensity that it may be recognized only by microscopy. It is contended that by the use of refined technic such as biomicroscopy and subdivision of the states of deficiency, a classification such as latent or subclinical is no longer necessary.

A "deficiency disease" should include any metabolic disturbance of the "essential" in the tissues and may arise from a great variety of causes, although generally from insufficient intake. In examining tissues for pathologic changes, a tissue must be selected in which early and progressive changes occur with the development of the deficiency state. The eye has been the organ of choice for vitamin A and riboflavin deficiency, the tongue for niacin deficiency, and the gums for ascorbic acid deficiency, each of which has yielded to the biomicroscopic technic.

In the study of niacin and ascorbic acid deficiency 49 adults, all working and apparently healthy individuals, were studied. Twenty-three were women; the monthly incomes ranged from $69 to $95, with 4 receiving more than $100. Their tongues and gums were examined grossly and with the biomicroscope. Every one of the individuals showed signs of niacin and ascorbic acid deficiency according to the author's criteria period. In chronic niacin deficiency, according to the degree of severity, the papillae may show a vascular hyperemia, proliferation, infiltration, and even atrophy, the fungiform papillae preceding the filiform in undergoing change. The tongue itself may show fissures, crevices, and loss of substance resulting in a thin tongue with eroded areas, although with less severe deficiency the tongue may be very thick and the papillae hypertrophied. These reversals and the particular sequence of events can apparently be distinguished by Kruse by the sequence of changes upon niacin treatment. The gross pathologic changes in the tongue during pellagra are well known, but equally recognized is the fact that many conditions of various origins can produce changes in the tongue, particularly small changes in the papillae (see review on "Tongue Changes in Nutritional Deficiency"). To be certain that the changes observed by Kruse are specifically concerned with mild niacin deficiency, it would be desirable to produce a mild deficiency in normal individuals under controlled conditions. To be sure, the findings of Kruse indicate that it would indeed be difficult to find a group of individuals with a biomicroscopically normal tongue. The next best method would be to observe the reversal of pathologic changes produced by the administration of niacin. Kruse treated 17 of the individuals with 200 mg. of nicotinamide daily; others receiving vitamin A and ascorbic acid served as controls. Those receiving nicotinamide showed a recession of the pathology, first the changes due to acute deficiency and, more slowly, those considered characteristic of chronic deficiency. However, after fourteen months of such therapy, only "three persons with their tongues showing almost complete restoration are near discharge." The less advanced cases were among the first to show complete recovery, requiring more than a year of such intensive therapy.

All are agreed that a pathologic change due to a deficiency state may be only slowly reversible. Thus, of course, the nerve degeneration of thiamine deficiency is slow to repair even with excessive thiamine therapy. When however, the pathology is so minor and possibly unspecific, the changes that take place over as long a period as one to two years may not be related solely to the nicotinamide therapy. Other changes in dietary habits and oral hygiene probably cause changes in an organ such as the tongue, and no control over other activities of these individuals was apparently exercised. "Control groups receiving ascorbic acid or vitamin A have shown no improvement in

their tongues," but the number of individuals in these groups was small.

In chronic ascorbic acid deficiency, the first signs may be a slight dilation and engorgement of the subsurface vascular papillae of the gums, imparting a slight redness and swelling to the gums. Later the redness may be obscured by edema and probably infiltration, followed by a heavier infiltration, distention, and hypertrophy. Atrophy in the form of microscopic pitting may occur. In severe chronic stages the atrophy may be profound, the papillae decrease or even disappear, and the gums may undergo extreme recession. All of the 49 subjects showed some of these changes.

Plasma ascorbic acid determinations permit comparison of Kruse's data with established facts of vitamin C nutrition. Of the 49 subjects, 43 per cent had less than 0.6 mg. per cent ascorbic acid in the plasma and 21 per cent less than 0.2 mg. per cent. Twenty-six per cent of the group had levels of 1.0 mg. per cent or more. Certainly the latter group would generally be considered to be near "saturation" and adequately supplied with ascorbic acid, and few clinicians would be dissatisfied with a plasma level of 0.6 mg. per cent in their patients. The theory that less than saturation amounts of ascorbic acid indicates a deficiency state is questioned by many investigators. Nevertheless all these subjects had gingival lesions. The general unreliability of blood vitamin determinations in detecting vitamin deficiency and the danger that such levels may reflect largely the recent intake, was discussed by Kruse. In the case of vitamin C however, countless studies have shown that plasma ascorbic acid values parallel roughly the state of vitamin C nutrition. The rapid equilibrium established between the blood and the tissues has often been shown. To be sure, low plasma values of ascorbic acid do not always indicate a low tissue level, but high plasma levels do not usually coexist with a tissue depletion. In fact when the tissues are depleted of ascorbic acid, oral ingestion of several hundred milligrams of ascorbic acid may fail to produce any appreciable rise in plasma ascorbic acid, so rapid is the flow of this substance into the tissues.

In spite of these known facts, all of Kruse's subjects, even those with adequate plasma ascorbic acid levels, showed gingival lesions considered by him to be associated with ascorbic acid deficiency. Kruse found no correlation between plasma ascorbic acid values and the extent of the gum lesions. Gross gingival lesions have long been recognized as one of the most constant signs of vitamin C deficiency, but again it is the minor gingival pathologic changes, perhaps recognizable only by the biomicroscope, which are in question. Seven subjects were given 500 mg. of ascorbic acid daily for over two months, when their plasma values were over 1.25 mg. per cent, without showing any appreciable change in the gum lesions. Only after a year of such intensive therapy with 25 subjects were "the gingival lesions in two . . . almost entirely gone, as judged in all instances by microscopic examination. The initially more severe lesions in the others of the therapeutic group have receded markedly, some nearly completely." The need of such a long period of therapy has not been the general experience of others, dealing of course with other criteria for the deficiency state.

The high incidence of nicotinic and ascorbic acid deficiency, even in a moderately low income group, and the time necessary for intensive therapy to bring only partial reversal of the pathology, arouses considerable doubt and question in the mind of the average student of nutrition. The ultimate critique or confirmation of Kruse's interesting report awaits the experience of others with the biomicroscope and the lesions which it reveals in carefully controlled experiments.

DETERMINATION OF NIACIN IN CEREAL PRODUCTS

Research workers who are interested in estimating niacin (nicotinic acid) will profit by reading a report which summarizes an extensive study on the applicability of microbiological and chemical methods to the determination of this vitamin in cereal products. This comprehensive collaborative program was sponsored by the Research Corporation of New York City; and a large number of workers from university and industrial research laboratories over the country were called together to discuss the suitability of microbiological and chemical methods for the assay of cereal products for thiamine, riboflavin, and niacin. Various committees were selected to study each of the methods, plan collaborative studies, and select standard procedures based on the results obtained. The present report on methods for the estimation of niacin was made by Daniel Melnick, Chairman of the Niacin Committee (*Cereal Chem.* **19,** *553 (1942)*).

The report is too voluminous and detailed to be treated adequately in a brief review. All collaborators received reference samples which consisted of (1) whole wheat flour, (2) air dried bread made from this flour, (3) white flour, and (4) air dried bread made from a white flour which had been enriched with niacin. Eleven collaborators submitted values obtained by microbiological methods of assay, and nine reports on chemical methods were received. Some workers conducted extensive experiments on modifications of methods to see if the time could be shortened or greater accuracy obtained.

The paper contains eight tables summarizing the results of different phases of the collaborative work and an appendix which contains detailed standard procedures used by the various workers. The report closes with a summary of the principal findings and references to the literature bearing on the subjects discussed. It is concluded that microbiological assays conducted on acid and alkaline extracts of cereal products yield reproducible, maximal values for niacin. All niacin is extracted by aqueous extraction, without preliminary enzymic digestion, but results obtained by microbiological methods, on such extracts, are lower than those obtained on acid or alkaline extracts. This is explained on the basis that acid and alkaline extraction causes hydrolytic cleavage of an unknown substance, yielding a stimulatory product. Whether or not this compound in the unhydrolyzed form is nutritionally available to the mammalian species is not known, although gastrointestinal pH conditions may favor the hydrolysis. It is believed that chemical methods may also include the unknown substance, since all chemical procedures involve preliminary hydrolysis. The significance of furfural as an interfering substance, when the chemical procedure is used, is discussed and it is concluded that in the collaborative method interference due to the presence of furfural in the final test solution is negligible. No loss of nicotinic acid occurs in the production of bread from enriched white flour or from whole wheat flour.

BLANCHING DRIED FOODS

Dehydrated foods of today are far superior in color, taste, and quality to those of 1918. One reason for this improvement has been the introduction of blanching or scalding. By this process the clean raw food is heated by steam or by immersion in hot water until most of the enzymes are inactivated. Steam blanching is preferable to

immersion in hot water for the reason that enzyme inactivation takes place without appreciable loss of valuable soluble nutrients, such as mineral salts and vitamins.

In the past, most manufacturers of dehydrated foods, like busy housewives, shoved the washed vegetables into the drier and hoped for the best. Modern manufacturers of dried foods are learning that various foods differ in ease of blanching. If blanching is incomplete, active enzymes remain in the dehydrated product and gradually cause chemical changes during storage, which bring about change in flavor, loss of palatability and color, and nutritive loss. The only sure way to reduce spoilage to a minimum is to make sure that the blanching process has inactivated the enzymes responsible for the trouble.

Proctor (*Food Industries* **14,** *51 (1942)*) recommends that every dehydration plant make use of well-known and simple catalase and peroxidase tests to insure top quality in the finished product. He states that by using proper enzyme control the producer can be assured that he has done everything possible to insure stability in storage; moreover, he will find that government inspectors will conduct tests on his finished product before recommending that the product be purchased.

Tests must be made immediately after the product is blanched in order to determine whether the time of blanching should be lengthened or the temperature of blanching increased. After dehydration nothing can be done about it.

The catalase test, using 3 per cent hydrogen peroxide, depends on the liberation of oxygen, if catalase enzymes are present. This test can be conducted qualitatively or semiquantitatively, preferably the latter. One gram of blanched food is ground in an equal weight of sand and 0.6 g. of calcium carbonate, diluted with distilled water and eventually diluted with hydrogen peroxide in a Smith fermentation tube. The amount of oxygen liberated can be measured. This test is excellent for carrots but is thought to be less satisfactory than the peroxidase test for most foods.

The peroxidase test is preferred because peroxidase enzymes require more severe blanching for inactivation. Two different peroxidase tests have been used with success. The first test depends on the formation of a red color if peroxidases are still active. This test requires the presence of an alcoholic solution of guiacol, water, and 3 per cent hydrogen peroxide in definite proportions. The second test is similar, using an alcoholic solution of benzidine and 3 per cent hydrogen peroxide solution to produce a blue color. In both cases the color produced is proportional to the amount of active peroxidase present. However, these tests are subject to error if the food material is contaminated with iron or copper salts due to contact with metal equipment.

While these tests do not actually measure the specific enzymes responsible for food spoilage and while the tests are not infallible, they are of great assistance in preventing instability during storage. Modern producers of dehydrated foods should make these simple tests a part of their routine quality control program.

EVAPORATED WHOLE MILK VERSUS "FILLED MILK"

The various groups interested in the increase of consumption of whole milk and its products have been greatly perturbed about the sale of so-called "filled milks." These are evaporated skim milks to which coconut fat or some other vegetable fat has been added to replace the butterfat. The evaporated filled milks are sold in competition with evaporated whole milks and, usually, at a lower cost to the consumer.

Both types of milk may be, and usually are, fortified with vitamin D. Recently there has been a tendency to enrich these products with vitamin A concentrates.

The sale of filled milks is prohibited in interstate commerce on the belief that these products are inferior in nutritive value to evaporated whole milks and that uninformed consumers are likely to purchase these substitutes under the impression that they are buying evaporated whole milk.

A recent attempt to answer the question regarding the relative nutritive merits of filled milk and evaporated whole milk is that made by Freeman and Ivy (*J. Dairy Sci.* **25,** *877 (1942)*). These workers have made a comparison of commercial evaporated milk and filled milk purchased on the open market. The latter contained coconut oil as a substitute for butterfat.

Chemical examination of the milks yielded the following:

	Total Solids	Fat	Nitrogen	Ash
	per cent	*per cent*	*per cent*	*per cent*
Evaporated milk	26.4	7.74	1.06	1.70
Filled milk	25.4	6.00	1.32	1.59

The evaporated milk "was said" to contain 325 U.S.P. units of vitamin D and 2000 to 3000 U.S.P. units of vitamin A "per can." The filled milk "was said" to contain 400 and 2000 U.S.P. units of vitamins D and A, respectively. These milks were fed to rats and comparisons were made of growth, bone ash, and the total and volatile fatty acids of liver and tissue fat.

Rats, 25 to 28 days of age, were fed the respective milks *ad libitum*, with daily supplements of iron, copper, and manganese. Two-thirds of the animals were killed on the forty-ninth day and the remainder were permitted to live for ninety-seven days.

In spite of the fact that the milks were not identical in chemical composition and the vitamin content was not known with certainty, the growth data showed no significant differences after forty-nine days. The rats on whole evaporated milk showed significantly better growth only after ninety-seven days. No differences could be noted in bone ash, amount of liver fat, or hemoglobin.

It was observed that the depot fat of the rats fed on filled milk contained a higher proportion of volatile fatty acids than that of rats fed on evaporated whole milk. The percentages of total acidity contributed by volatile fatty acids were 16.3 and 5.0, respectively. Loose stools were characteristic for the rats which were fed on filled milk during the last forty-eight days of the ninety-seven day experiment. This alone may have accounted for a part of the growth differences noted in the ninety-seven day experiment.

While studies of the type described have yielded interesting and useful information, the problem is of sufficient importance to the public at large to merit most careful examination from every conceivable angle. Before all questions can be answered satisfactorily, milk from the same source must be used to make both types of products. The vitamin additions must be identical in source and number of units. Fundamental chemical and physiologic studies are needed to answer some of the questions that naturally arise. Is there a hitherto unknown essential factor in butterfat not contained in other fats?

Some further information on this problem is available. Studies on the intrinsic dietary value of butterfat carried on at the Wisconsin Agricultural Experiment Station by Schantz, Elvehjem, and Hart (*J. Dairy Sci.* **23,** *181 (1940)*) have shown that rats which are weaned very early grow somewhat better during the first few weeks on whole milk than they do on filled milks containing corn, coconut, cottonseed, or soybean oil in place of butterfat. In attempts to fractionate butterfat it was shown that the "activity" was in the saturated fatty acid fraction although it is not yet clear just what is specific

about this fraction from butterfat. Gullickson and Fountaine (*J. Dairy Sci.* **22,** *471 (1939)*) have found butterfat to be superior to certain vegetable oils in similar experiments using growing calves. However, in work with "adolescent" rats, Harris and Mosher (*Food Research* **5,** *177 (1940)*) reported that coconut oil gave better growth than butterfat. In similar experiments but using weanling rats, Harris and Rosenfeld observed better growth when butterfat was fed as compared to coconut oil. Apparently age or accidental variations played an important role in these results. At the present time then, there is evidence to indicate that whole milk is superior to filled milk for very young animals and therefore it should be preferred for infants, but no advantage has yet been demonstrated for it as a food for older animals.

The commercial practice of selling milk entirely upon its fat content has long thrown undue emphasis upon this constituent. A considerable part of the nutritive value of milk results from the calcium, phosphorus, protein, and water soluble vitamins, particularly riboflavin, which it contains. These are entirely independent of the fat content. The present practice of fortifying vegetable oils with vitamins A and D also eliminates much of the previous criticism of food products containing these oils in place of butterfat. Milk protein which is lost from human consumption by not using the large quantities of available skim milk represents a tremendous waste of first class food—a protein of the highest nutritional value. It has recently been stated by Jones, Morse, and Pollack (*Nat. Res. Council, Reprint No. 114, Aug. (1942)*) that the milk protein remaining on the farms each year is equivalent to the protein content of 20 million beef steers. Such tremendous wastes of protein, calcium, riboflavin, and other constituents of skim milk in a world that is in need of food certainly should provoke serious thought and prompt action on methods of diverting at least some of this into food for human consumption. Greater use of skim milk in foods for man can be accomplished in many ways other than its use in "filled milks," and many agencies, including the Department of Agriculture and the National Research Council are at work on the problem.

VITAMIN C IN CHILDREN

There has been considerably less work done on the vitamin C intake and requirements of infants and children than of adults, yet adequate nutrition during this period of active metabolism is probably more important than at any other time of life.

It has been relatively easy to assess the dietary intake of vitamin C in breast-fed infants by analysis of the mother's milk. Providing the mother's diet is adequate with respect to vitamin C, the infant appears to receive some 10 mg. of ascorbic acid daily until lactation is fully established, when 20 mg. or more may be obtained, increasing to 50 mg. at a weaning age of 9 to 10 months. The lower vitamin C content of cow's milk or stored mother's milk fully justified supplementing such formulas with vitamin C in the infant's diet. The extensive work of Hamil, Reynolds, Poole, and Macy (*Am. J. Dis. Child.* **56,** *561 (1938)*) demonstrated that a minimum level of 10 mg. of vitamin C daily was required by artificially-fed infants to prevent symptoms of scurvy.

Latent vitamin C deficiency may be fairly common in children. Minot, Dodd, Keller, and Frank (*J. Pediatrics* **16,** *717 (1940)*) studied over 500 children and concluded that a serum level of over 0.7 mg. of ascorbic acid per 100 ml. serum indicated

satisfactory vitamin C nutrition and a level below 0.3 mg. pointed to a serious deficiency. Of 533 children, 380 had no serious sickness while 153 were sick to various degrees. The percentage of children with a low serum ascorbic acid content was higher in the "sick" group than among the healthy children. In both groups the younger children showed the greatest degrees of unsaturation. No classical signs of scurvy were observed, but the occurrence of symptoms such as lack of energy, loss of appetite, mental apathy, and retarded development may well prevent or obscure gross symptoms of scurvy because of the general inactivity of the sick children. This hypothesis has some support in the fact that the severe manifestations of scurvy in adults have generally been observed in groups leading active lives and exposed to extremes of climate.

The determination of the intake and requirement of older children presents problems similar to those encountered with adults. This problem has been approached from different angles in two recent publications.

In studies by Bessey and White (*J. Nutrition* **23,** *195 (1942)*), children coming to the Forsyth Dental Infirmary were tested four to twenty-four hours after the last intake of a potent source of vitamin C. Plasma ascorbic acid was determined by a previously described microphotoelectric technic which requires only 0.25 ml. of blood, collected by ear puncture. All the children selected were given medical examinations on the day of the test so that any showing evidence of the presence of colds or other acute infections, could be eliminated from the study. The children were from families in the lower income brackets, many receiving assistance from public or private relief agencies.

Values for the consumption of ascorbic acid were based on dietary histories secured by personal clinic interviews with mother and child. In addition, on the day that the plasma ascorbic acid was determined, the mother and child were questioned extensively as to the food eaten during the twenty-four hour period previous to the clinic visit. Habits with respect to the consumption of foods which would be expected to supply appreciable amounts of vitamin C were recorded. On the basis of all the above information, an estimate was made of the amount of ascorbic acid consumed daily by each child. The high variability in the vitamin C content of fresh foods plus great differences in degree of destruction due to crushing and holding, to cooking, and to other methods of treatment, raise questions as to the accuracy of the estimation of vitamin C in the diet obtained in this way even by a highly competent nutrition specialist. It is not surprising, therefore, that the authors report poor correlation between plasma ascorbic acid and total calculated intake. It is interesting, on the other hand, to note that whatever doubts there may be as to the absolute ascorbic acid values attributed to the total diet, there appears to be a fair correlation between the estimated ascorbic acid intake in the form of citrus fruits and tomatoes, and the plasma ascorbic acid determination. There was, however, a considerable scattering of plasma values for any one level of dietary intake. This may be due in part to the fact that there was no indication as to the distribution of children according to age, size, or activity, as related either to plasma vitamin C or to dietary intake. The age range of the children was wide (5 to 13 years, inclusive). Approximately equal numbers of boys and girls, 93 in all, were studied, but their distribution in the age range was not indicated. It appears that the considerations noted might be of comparable significance with those cited in the conclusion drawn by the authors: "This indicates a rather wide individual dispersion in the effect of a given quantity of orange juice on the blood plasma ascorbic acid level, and, therefore, suggests

the caution which is necessary in evaluating the state of ascorbic acid nutrition of an individual by this method; but in spite of this variation, there is a clear tendency for the points to concentrate around certain values."

Up to the level of 45 mg. of ascorbic acid daily intake from citrus fruit or tomatoes, the average ascorbic acid value of the blood plasma increased steadily. Beyond this point, the average increase, if any, was slight. This led the authors to conclude that a supplement of 40 to 50 mg. of ascorbic acid daily (approximately 3 ounces of orange juice) is sufficient to produce an optimal postabsorptive plasma ascorbic acid in children of this age group. Some individuals had a characteristically low plasma level even when the ascorbic acid intake was high. The authors suggest also that differences in the total amounts of other fruits and vegetables in the diet of children on approximately the same citrus fruit intake, made little difference in average plasma values. They consider this an indication of low vitamin C values for the other fruits and vegetables eaten.

In 8 children who consumed practically no citrus fruits or tomatoes for several months previous to the study, the blood plasma values were practically zero. In four of these children, no clinical evidence of scurvy was found, leading to the conclusion that sufficient vitamin C had been ingested in other foods to prevent scurvy. The data indicate that low plasma levels are not necessarily indicative of this disease. Until better methods of fixing the physiological optimum are available, however, the authors recommend an intake within the range of the physiological maximum and suggest that the evaluation of citrus fruit and tomato intake is a simple, practical, and accurate means of determining the ascorbic acid status.

For further illumination of the question of optimum intake, an intensive study of 5 children ranging from 7 to 12 years of age, by Roberts and Roberts (*J. Nutrition* **24,** *25 (1942)*) is helpful. Several criteria for estimating requirement were used. The actual vitamin C content of the regular diet was determined by Bessey and King's method, and found to average 50 mg. daily. The low blood levels of ascorbic acid, determined by the micro method of Farmer and Abt, indicated that this amount was inadequate. A basal diet furnishing 15 mg. ascorbic acid daily was given to the children and the effects of additional crystalline ascorbic acid was observed. The "retention" or "utilization" of ascorbic acid was taken as the difference between dietary intake and urinary output. It was found that retention values varied with the weight of the child rather than the age, ranging from 35 mg. for the smallest to 47 mg. for the largest child. These average retentions occurred on intakes of 55 to 75 mg. The average urinary excretion ranged from 16 mg. on an intake of 55 mg. to 91 mg. on an intake of 135 mg.

The response to a 300 mg. test dose showed that 50 per cent was excreted by one patient after a period on a 65 mg. intake, by 3 after a 75 mg. level, and by one after a 95 mg. daily intake.

The problem of what should be considered a satisfactory blood ascorbic acid value was considered. Blood levels were reported at various levels of intake. Taking all criteria into consideration, the authors conclude that an intake of 65 mg. for the 2 youngest children and 75 mg. for the 3 oldest children would be sufficient to maintain a blood level above 0.7 mg. per 100 ml., provide for maintenance of an average retention value, and produce a 50 per cent excretion of a test dose. This represents a requirement range of 1.7 to 2.4 mg. per kilogram of body weight. The authors call attention to the fact that their results with pure ascorbic acid agree essentially with Bessey and White's findings in which vitamin C was ingested as citrus fruit or tomato.

NOTES

War and Nutrition

"War has few virtues. One undoubtedly is that activity in many fields of enterprise is enormously stimulated. Another is that problems can often be lifted clear of the arena of political dispute. This war of liberation will offer some compensation for the devastation and waste of human effort if it brings nearer by years the day when every man, woman, and child can be assured that they will never know the want of the foods on which their health depends. Not until that day dawns can the Atlantic Charter, calling for freedom from fear, freedom from want, become reality." (J. C. Drummond in a paper read before the Royal Society of Arts, London.

Technical Reports on Dehydration

The Department of Agriculture, both in Washington and in its many state and regional affiliates, has been giving increasing attention to the many problems of food dehydration. A number of technical reports have been prepared that will be of interest and value to those who are working actively on dehydration problems; these may be obtained when critically needed by writing to the Office of the Secretary.

Hard and Soft Wheat

In papers dealing with wheat and wheat flours the terms "hard wheat" and "soft wheat" are frequently used. Hardness or softness refers, primarily, to the gluten characteristics of the wheat. Gluten from hard wheats is tougher, more elastic, and takes up water more efficiently than soft wheat gluten. Furthermore, hard wheats usually contain more gluten than soft wheats. Climatic conditions (especially rainfall) are largely responsible for the type of wheat produced. Hard wheats are produced in areas of comparatively low rainfall, and hot dry climates are necessary for proper ripening. Soft wheats are grown in areas of comparatively high rainfall and a fairly cool ripening season. A hard wheat is no longer hard when grown under wet and cool conditions. A soft wheat becomes harder when grown under dry conditions. Flour produced from hard wheats is used principally for bread production while soft wheats are used mainly for production of crackers, pretzels, pastries, and sweet goods.

Philosophical Views on Milk

"This view of the nature of aliments is singularly illustrated and maintained by the familiar instance of the composition of *Milk*. All other matters appropriated by animals as food, exist for themselves; or for the use of the vegetable or animal of which they form a constituent part. But milk is designed and prepared by nature expressly as food; and it is the *only material* throughout the range of organization that is so prepared. In milk, therefore, we should expect to find a model of what an alimentary substance ought to be —a kind of prototype, as it were, of nutritious materials in general. Now, every sort of milk that is known, is a mixture of three staminal principles we have described; in other words, milk always contains a *saccharine* principle, a butyraceous or *oily* principle, and a *caseous*, or strictly speaking, an *albuminous principle*. Though, in the milk of different animals, these three staminal principles exist in endlessly modified forms, and in very different proportions; yet neither of the three is at present known to be entirely wanting in the milk of any animal." [Prout, William: *Chemistry, Meteorology and the Function of Digestion considered with reference to Natural Theology*. London, 1834. pp. 481–482].

Nutrition Yardstick

The Department of Nutrition, National Live Stock and Meat Board, 407 South

Dearborn Street, Chicago, Illinois, has prepared a "Nutrition Yardstick," a graphic calculator designed to assist dietitians and nutritionists in determining the food value and adequacy of any diet. The requirements used in the Yardstick are those set up by the Food and Nutrition Board of the National Research Council and they are given for six groups: man, woman, preschool child, school child, adolescent girl, and adolescent boy. Attached to the Yardstick is a table of food values for 539 foods and recipes. Vitamin content of cooked foods is included whenever reliable figures could be found.

More Food in Smaller Space

"You ain't seen nothin' yet" is the essence of L. V. Burton's challenge to food manufacturers (*Food Industries* **14,** *37* (*1942*)). He predicts that foods and food processing technics will undergo changes that may jar our sensibilities. These changes, accelerated by the war, will tax the ingenuity and resourcefulness of all food processing industries. He points to the loss in cargo ships, lowered food production in many parts of the world, and lack of steel, tin, and other essential packaging materials. The thesis is advanced that dehydration is not enough; we must find ways and means of manufacturing more compressed foods, in order to conserve shipping space. The author points out that the need will be even more imperative if we resort to the use of cargo planes. He asks that food technologists consider this a direct challenge, and that they get busy immediately and find more compact forms in which many of our common foodstuffs can be packaged and shipped.

Food Production, Processing, and Distribution

"To bring the wartime food program through to success, the unity of effort and understanding must extend past the farm. Food is not really produced until it is at the place where it is to be eaten. A hog in the farm truck headed for the packing plant is not food. Its carcass on the hook in the packing house cooler still isn't food. The food isn't truly produced until it is on your table, or in the mess kit of a Marine in the Solomons, or the field ration box in the pack of a soldier in North Africa.

"This food business is all one. The farm production must be processed and packaged and shipped and distributed before food can win the war—or write the peace."—Address by Claude R. Wickard, Secretary of Agriculture, Chicago, December 3, 1942.

Psychology and Hypovitaminosis

Karpovich and Millman (*New Engl. J. Med.* **226,** *881* (*1942*)) used the "arm-holding" and "breath-holding" tests of McCormick (*Med. Record* **152,** *439* (*1940*)) to measure the effect of extra thiamine upon endurance. They made one improvement upon McCormick's technic in that they also tried the effect of "pep talks" upon "arm-holding" ability in 2 groups of subjects who did not receive thiamine. The subjects who had received 5 mg. of thiamine daily during the week prior to the test day showed no greater ability than the control group (who received a placebo containing 5 mg. of lactose to allow them a little psychological development), but those subjects who received the "pep talks" showed marked improvement in endurance as tested by "arm-holding." One cannot argue too strongly for the careful consideration and evaluation of psychological factors in any tests of function or subjective response performed on human beings.

Recent Nutrition Books

Minerals in Nutrition. Zolton T. Wirtschafter, M.D. Reinhold Publishing Corp., N. Y. 1942. pp. 175.

The Freezing Preservation of Foods. Donald K. Tressler, Ph.D. and Clifford F. Evers, B.S. The Avi Publishing Co. Inc., N. Y. 1942. pp. 763.